*Vestnik zoologii*, **33**(3): 47–56, 1999


УДК 567.432 : 551.734(477.8)

# THE NEW FORMS OF PTERASPIDS (AGNATHA, HETEROSTRACI) FROM PODOLIAN EARLY DEVONIAN

**V. K. Voichyshyn**

*State Museum of Natural History, Lviv, UA-290008 Ukraine*

Accepted 26 November 1997

**The New Forms of Pteraspids (Agnatha, Heterostraci) from Podolian Early Devonian. Voichyshyn V. K.** — Two new genera and three species and as well as the remains of a new representative of pteraspids described from Lower Devonian ("Old-Red" deposits) of Podolia. The name of the species "*Pteraspis*" *angustata* Alth, 1874, are known only from dorsal shields is shown to be valid. Some new terms in pteraspids morphology are proposed.

Key words: Agnatha, Pteraspidiformes, Podolia, Esrly Devonian, taxonomy, morphology.

**Новые формы птераспид (Agnatha, Heterostraci) из раннего девона Подолья. Войчишин В. К.** — Из красноцветных отложений нижнего девона Подолья описано 2 новых рода и 3 вида, а также остатки нового представителя птераспид. Показано, что название вида "*Pteraspis*" *angustata* Alth, 1874, который известен лишь по дорсальным щитам, может считаться валидным. Предлагается использовать некоторые новые термины в морфологии птераспид.

Ключевые слова: Agnatha, Pteraspidiformes, Подолье, ранний девон, систематика, морфология.

Owing to numerous finds during long research period (practically leading off A. Alth's works, 1874–1884), pteraspids (order Pteraspidiformes) from Podolia have been studied perhaps better than in other world locations. Regional fauna of these fossil animals numbers (according to the results of publications analysis) about 25 species and, as it follows from the subject of this article, is still numerous. For comparison, according to A. Blieck (1984), 16 species of pteraspids have been known in the Middle West of USA, about 14 ones in England and Wales, 9 ones in the Canadian Arctic, 7 in Belgium and adjacent regions of France and Germany, about 6 species in Spitsberg, and so on.

For faunistic research (concerning pteraspids, particularly) almost the whole Podolian Lower Devonian section which have been divided (Drygant, 1988) upwards into Borshchiv, Chortkiv and Ivanie Horizons, Ustechko, Khmeleva, Strypa and other Suites is of considerable interest. Deposits of Ivanie Horizon are interesting by earliest fairly abundant macroremains of ichthyofauna which moreover often distinguish itself by well preserved exoskeleton. Taking into consideration that Ivanie time apparently concerned an epoch of development of various phylogenetic lines of pteraspids, one can expect here much greater variety of its forms than it is known now. Pteraspids fauna of the first "Old-Red" zone (according to the scheme of F. Brotzen (1936)) which includes Ustechko Suite and the base of Khmeleva Suite is most various in both quantitative and qualitative respects. Since majority of forms which are being described below come from here, it is highly possible that specific potential of this association hasn't been exhausted yet. The second "Old-Red" zone which corresponds to the rest of Khmeleva Suite is short of vertebrates remains, probably in consequence of unfavourable facial conditions of sediments accumulation. Only three genera (*Althaspis*, *Brachipteraspis* and *Europrotaspis*) have been known in the third zone (from the base of Strypa Suite and upwards (Narbutas, 1984)). But to judge from the pteraspid remains, which have been described below and determined as Pteraspidoidei incertae sedis, one can hope for new (in taxonomic respect) finds in the upper part of Podolian Lower Devonian exposure as well.

Besides the fossils concerning a few new pteraspid forms the remains of "*Pteraspis*" *angustata* Alth, 1874 have been described in the article. This species is known only by dorsal shields which clearly stand out among the other species shields for their shape and size. This is the reason to think that species which was established by A. Alth remains valid up to now.

Some terms and morphometrical indices that have been used in descriptions need an explanation. The continuous orbito-pineal belt of pteraspids (see Novitskaya, 1983) which has more or less wide contact between its components (pineal and orbital plates) can be defined as "equicontact", if medial orbital processes are of the same width as lateral margins of pineal plate, and as "unequicontact", if they are narrower.

Typical equicontact orbito-pineal belt is peculiar, for instance, to genus *Althaspis* and unequicontact one to *Larnovaspis major* (Zych, 1927). But both variants are available in *Zascinaspis heintzi* (Brotzen, 1936). Dorsomedial sensory-system canals of pteraspids on coming out of the primordial zone of dorsal shield are directed as a rule either to lateral parts of pineal plate (canals of parallel type) or to the base of medial orbital processes (those of radial type). Apparently the disposition of the canals appears to be an important taxonomic indication. In contrast to ratio of plate length or width to the total length of carapace (which is not often known) to be commonly used (Blieck, 1982), the ratio of plate length to its width (the indices RL/RW[1] and DW/DL particularly) allows to draw much more material into morphometrical analysis. Index RL/RW was used by A. Blieck (1982) in description of Spitsberg pteraspids. But till now such indices have not been utilized in morphometrical analysis of Podolian pteraspids.

All specimens which have been described below are preserved in State Museum of Natural History of the National Academy of Sciences of Ukraine (further SMNH), GVTV.

## Class HETEROSTRACI[2]

## Order PTERASPIDIFORMES

## Suborder Pteraspidoidei

## Family Larnovaspididae Halstead[3]

## Genus *Alaeckaspis* Voichychyn, gen. n.

*Pteraspis*: Brotzen, 1933, S. 454–455 (pars).
*Errivaspis*: Blieck, 1984, pp. 47–48, 83 (pars).

Derivation of name. After Dr . Alain Blieck.

Type species. *Alaeckaspis verbivciensis* sp. n., Lower Devonian (the base of Dniester Series) of Podolia, Ukraine.

Diagnosis[4]. Pteraspids of average size (tL is 9.5–13 cm). Dorsal carapace is fairly slender. Index RL/RW 0.8. The orbito-pineal belt is wide and equicontact. Orbital plates are massive, with noticeably developed anterior processes and rather short, wide and wedge-shaped medial ones. Pineal plate is large, with convex posterior margin, and amounts about 1/3 of orbito-pineal belt extent. Dorsal shield is not wide (DW/DL 0.53–0.61). Cornual plates are narrow and elongated. Dorsomedial sensory canals are of parallel type.

Comparisons. In contrast to genus in question *Larnovaspis* doesn't have so massive orbital plates (in particular, less developed anterior orbital processes), has much lesser pineal plate, wider and, on the whole, greater cornual plates. *Errivaspis* has more wide carapace, lesser pineal plate, longer medial orbital processes and much lesser anterior ones[5]. *Belgicaspis* has different shape of rostral and pineal plate and lesser size of latter. *Brachipteraspis* has more wide carapace, lesser elements of orbito-pineal belt, greater branchial plates and dorsomedial sensory canals of radial type. *Zas-*

---

[1] Designations: BrL, (visible at dorsal side) length of branchial plate; CL and CW, respectively, length and width of cornual plate; cr/mm, number of dentine ridges on 1 mm of exoskeleton ornament; DL and DW, length and width of dorsal shield; OL, length of orbital plate; PL and PW, length and width of pineal plate; RL and RW, length and width of rostral plate; tL, total length of dorsal carapace. In all cases the length of plates was measured to be parallel and the width to be perpendicular to body axis.

[2] As to the rank of Heterostraci I hold with L. I. Novitskaya (1983).

[3] See L. I. Novitskaya (1986).

[4] The antero-lateral (? orbital) hollows which were formed at the anterior margin of dorsal shield in the juvenile ontogenetic stage have been found in the holotypes of both *Alainiaspis* species described below. Subsequent research will enable to ascertain whether this phenomenon is a feature of the genus or is inherent in other pteraspids too.

[5] Some specimens belonging to *Errivaspis waynensis* (White, 1935) (viz. *Pteraspis rostrata* var. *toombsi* White, 1935; see Blieck, 1984: fig. 19 D, E, F), the type species of genus, have large orbital plates which are fairly like the plates of *Alainiaspis* gen. n. Possibly these are the aberrant specimens of *E. waynensis*.

*cinaspis* has different shape of rostral, orbital and dorsal plates. By general shape of carapace, rostral, dorsal and, probably, cornual plates new genus is most similar to *Djurinaspis*, but differs from it by greater orbital plates (with developed anterior and wider medial processes) and (longer) pineal one.

Other species. *A. ustetchkiensis* sp. n., *A. magnipinealis* (Brotzen, 1933) and, perhaps, *A.* (?) *depressa* (Stensiö, 1958), all are from Lower Devonian of Podolia, Ukraine.

Remarks. L. I. Novitskaya (1986) considers that *Pteraspis magnipinealis* Brotzen virtually does not differ from large *Zascinaspis heintzi* specimens (Institute of Paleontology of Russian Academy of Sciences[6], № 3592/27 and 3592/72) by shape of plates of orbito-pineal belt and on these grounds brings it into synonymy of this species. Specimen PIN № 3592/27 has been shown in illustrative material by the photograph of rostral plate ornament only (Novitskaya, 1986: tabl. XXII, figs. 1, 5) and therefore is not available for comparison with Brotzen's specimen. Specimen PIN № 3592/72 (Novitskaya, 1983: tabl. XXX, fig. 2) really has wide ribbon-like orbito-pineal belt, but, apart from superficial resemblance, its shape and size, as well as those of its separate plates, are noticeably differ from corresponding characteristics of *magnipinealis*. Pineal and orbital plates of latter are more massive: anterior orbital processes are pointed and stretched forward much farther than those of mentioned specimen from PIN (and of *Zascinaspis heintzi*, as a whole), medial processes are shorter and wider, pineal plate is also greater (and amounts about 1/3 of belt length in *magnipinealis* against 1/5 of this in *heintzi*). Besides these distinctions there are others not less important. Rostral plate of *magnipinealis* is narrower (RL/RW 0.8 to 0.5–0.6 of *heintzi*) and dorsal shield is more slender (DW/DL 0.61 to 0.77–0.91 of *heintzi*). Thus Brotzen's taxon is valid.

*Plesiopteraspis* (?) *depressa* Stensiö has been attributed by Novitskaya (1986) to genus *Larnovaspis*, but it has a series of different features which were, at the same time, shared by *Alaeckaspis* gen. n. The question is on considerable size of anterior orbital processes and very narrow cornual plates. Besides, carapace on the whole is narrower than that of *Larnovaspis*. A. Blieck (1984) attributes *depressa* to genus *Errivaspis* on the grounds, as it follows from the genus diagnosis, of rather narrow dorsal shield, "v"-like pineal plate and narrow cornual plates. But the type species, *E. waynensis*, has wider and shorter dorsal shield (DW/DL 0.71) than *depressa* does (DW/DL 0.52). Also excessive development of the latter's anterior orbital processes has been left out of account[7]. At the same time small size of pineal plate[8] gives no ground to attribute this species to *Alaeckaspis* gen. n. with certainty.

Occurrence. Lower Devonian of Podolia.

***Alaeckaspis verbivciensis*** Voichychyn, **sp. n.** (fig. 1–2)

Material. Besides holotype, more or less preserved moulds of dorsal carapace, SMNH № 31395/1–3, 31399/2–4, 31412/1–2, 37712, 37718, 37719.

Derivation of name. After type locality, Verbivci.

Type specimen. Holotype, specimen SMNH № 31399/1; the mould of dorsal carapace.

Type locality. Ukraine, Podolia, Verbivci.

Type horizon. Lochkov, Dniester Series, probably, Ustechko Suite — (?) the base of Khmeleva Suite.

---

[6] Further PIN.

[7] The difference by this feature between both species is quite clear in their reconstruction (Blieck, 1984; figs. 43 A and C), but essentially there is no one in the figures of some specimens of *E. waynensis* and in that of *depressa* lectotype (Blieck, 1984; figs. 19 D, E, F and 21 A).

[8] Judging from figure of sole species specimen which to be known (Blieck, 1984; fig. 21 A), the pineal plate has not been preserved and its reconstruction is, to some extent, a conjecture.

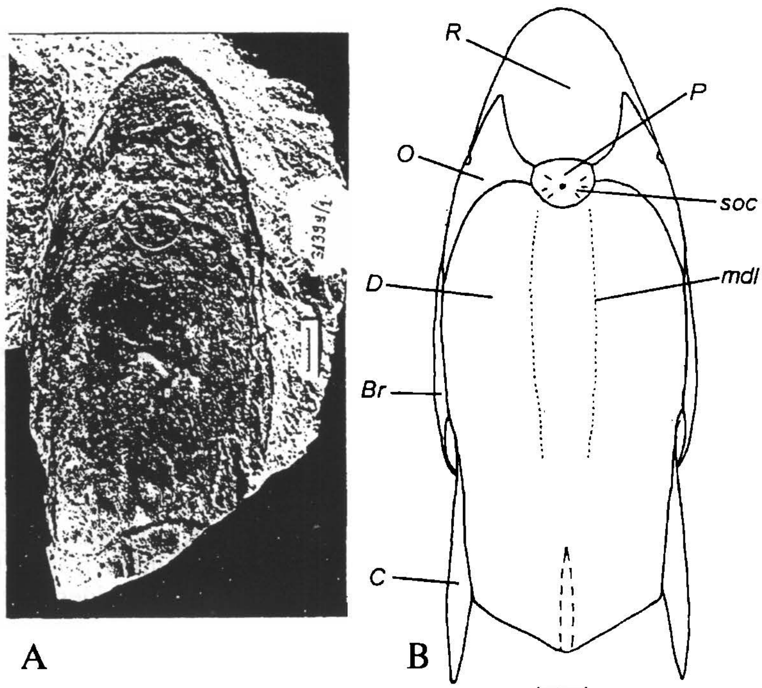
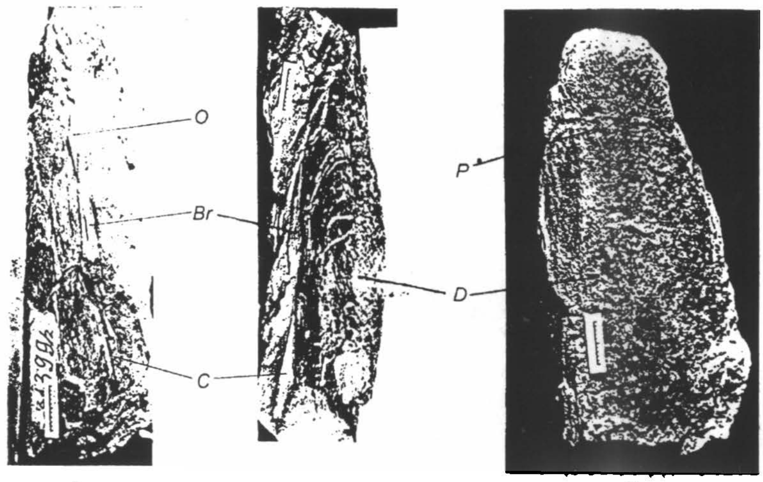



Fig. 1. *Alainiaspis verbivciensis* A, holotype, the carapace without posterior part (collection of SMNH, № 31399/1), dorsal view. **B**, reconstruction of the carapace based on the holotype and other specimens (mainly on № 31399/3, 31412/1 and 37718): *Br* — branchial plate; *C* — cornual plate; *D* — dorsal plate (shield); *mdl* — dorsomedial sensory canal; *O* — orbital plate; *P* — pineal plate; *R* — rostral plate; *soc* — pores of supraorbital sensory canal. The scale is equal to 1 cm at all figures.

Рис. 1. *Alainiaspis verbivciensis* A, голотип, панцирь без задней части (коллекция ДПМ, № 31399/1), с дорсальной стороны. **B**, реконструкция панциря, на основе голотипа и других образцов (главным образом № 31399/3, 31412/1 и 37718): *Br* — бранхиальная пластинка; *C* — корнуальная пластинка; *D* — дорзсальная пластинка (щит); *mdl* — дорсомедиальный сенсорный канал; *O* — орбитальная пластинка; *P* — пинеальная пластинка; *R* — ростральная пластинка; *soc* — поры супраорбитального сенсорного канала. Длина мерной линейки на всех рисунках составляет 1 см.

Description. Dorsal carapace is 10—12 cm in length. Rostral plate is with somewhat widely rounded anterior margin and only just convex lateral ones. Anterior orbital processes are massive, fairly elongated and pointed, median ones are wedge-shaped and noticeably narrow at the contact with lateral margins of pineal plate. The pineal plate is large (in holotype its length is 9.9 mm and width is 13.6 mm), rather stretching laterally, rounded, with convex margins. It takes up 29—30 per cent of orbito-pineal belt extent. Dorsal shield is widest in prebranchial part and grows narrow in postbranchial one (DW/DL 0.53—0.56). Cornual plates are very narrow (each about 40—45 mm in length and 5 mm in width), with elongated and sharp posterior end which is directed backwards and slightly sideways, reaching far behind posterior margin of dorsal shield. Dorsomedial sensory canals are directed to lateral parts of pineal plate. Dentine ridges of exoskeleton ornamentation are of different width: they are of 4.5 cr/mm in primordial zone, 5.5 in centre and 7 cr/mm at anterior margin of ventral shield, 5—6 cr/mm in the primordial zone and 7 at the anterior margin of dorsal shield, and up to 10—11 cr/mm in branchio-cornual region of dorsal carapace.

Comparisons. The taxon differs from other species of genus by shape of pineal and cornual plates. Furthermore, *A. ustetchkiensis* sp. n. has less massive orbital plates (with shorter anterior processes), not so narrow dorsal shield in postbranchial part.




A B C

Fig. 2. *Alainiaspis verbivciensis* A, the mould of carapace with fragments of the exoskeleton (SMNH, № 31399/2), right side view. B, left part of dorsal carapace (SMNH, № 31399/3). C, fragmentary mould of carapace (SMNH, № 37712), dorsal view. Designations are the same as in previous figure.

Рис. 2. *Alainiaspis verbivciensis* A, ядро панциря с фрагментами экзоскелета (ДПМ, экз. № 31399/2), справа. B, левая часть дорсального панциря (ДПМ, экз. № 31399/3). C, частичное ядро панциря (ДПМ, экз. № 37712), с дорсальной стороны. Обозначения те же, что и на предыдущем рисунке.

*A. magnipinealis* has considerably wider (and comparatively shorter anterior) orbital processes. *A.* (?) *depressa* has less massive orbital plates.

Localities. All specimens are from Verbivci.

***Alaeckaspis ustetchkiensis*** Voichyshyn, **sp. n.** (fig. 3)

Material. Holotype.

Derivation of name. After type locality, Ustechko.

Type specimen. Holotype, specimen SMNH № 37682 a-b; a mould of dorsal carapace (without rostral part) and its impress.

Type locality. Ukraine, Podolia, the left bank of Dniester, Ustechko.

Type horizon. Lochkov, Dniester Series, the base of Khmeleva Suite.

Description. Length of dorsal carapace is probably about 10.5 cm. Pineal plate is comparatively very large (its length is 8 mm and width 11 mm) and takes up 32 per cent of orbito-pineal belt length. Anterior and lateral margins of this plate are direct. The lateral margins at their full length are in close contact with relatively short and wide medial orbital processes. Posterior margin of pineal plate is very convex and rounded. Anterior orbital processes are short, wide and pointed, posterior ones are long. Ratio DW/DL is equal to 0.57. Anterior margin of dorsal shield has deep pineal hollow while posterior one has small medial projection. Groove of base of dorsal process is narrow with length of 2 cm. Cornual plates are narrow, 2.5 cm long, with their posterior ends reaching backwards posterior margin of dorsal shield. Dorsomedial sensory canals are directed to tops of medial processes of orbital plates. There are 5 cr/mm in the primordial zone of dorsal shield, 6 on pineal plate, 7 on dorsal and branchial plates and 7—8 cr/mm on rostral plate.

Comparisons. This species differs from *A. magnipinealis* by less width and size, and by different shape of elements of orbito-pineal belt, and from *A.* (?) *depressa* by shorter and wider medial orbital processes and noticeably shorter anterior ones, moreo-

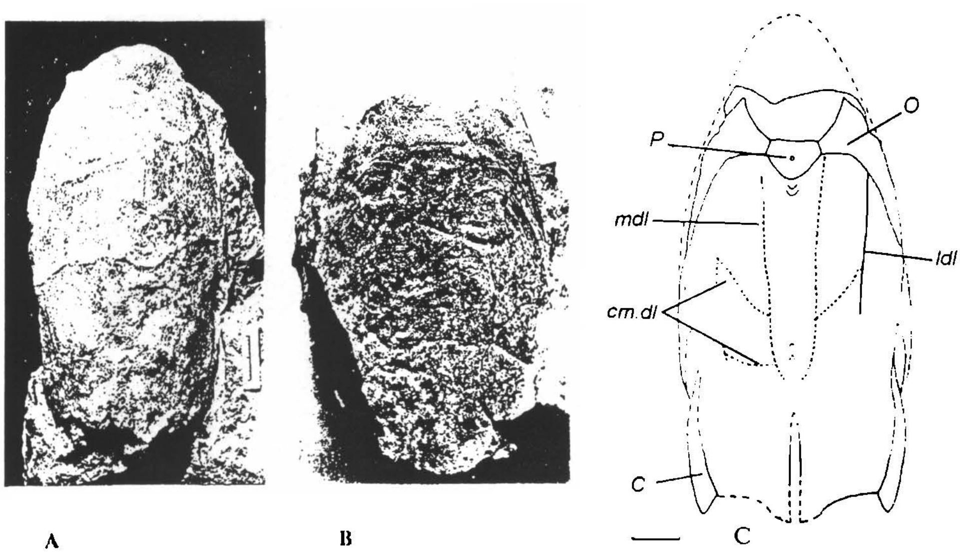



Fig. 3. *Alainiaspis ustetchkiensis* A, B, holotype, correspondingly, fragmentary mould and impress of dorsal carapace (SMNH, № 37682 a–б). C, reconstruction of the carapace, dorsal view: *cm. dl* — dorsolateral commissure, *ldl* — dorsolateral sensory canal, other designations are the same as in previous figures.

Рис. 3. *Alainiaspis ustetchkiensis* A, B, голотип, соответственно, частичные ядро и отпечаток дорсального панциря (ДПМ, экз. № 37682 а–б). C, реконструкция панциря с дорсальной стороны: *cm. dl* — дорсолатеральная комиссура, *ldl* — дорсолатеральный сенсорный канал, остальные обозначения те же, что и на предыдущих рисунках.

ver, by greater pineal plate (with considerably convex posterior margin). Distinctions from *A. verbivciensis* sp. n. have been given with its description.

Remarks. *A. ustetchkiensis* sp. n. bears resemblance to specimen PIN № 3592/28 (Novitskaya, 1986: text-fig. 52, tabl. XXII, fig. 2; *Zascinaspis bryanti* (Brotzen, 1936), in L. I. Novitskaya's conception) in morphology of orbito-pineal belt, especially in shape of pineal plate and of its contact with orbital ones. But posterior margin of pineal plate of specimen described stretches like drop and the pineal spot is considerably lesser. Among different morphological features of orbito-pineal belt it is also desirable to note the shape of anterior orbital processes, in particular, the line of antero-medial margin of orbital plates and greater width of medial processes.

## Incertae familiae

### Genus *Pavloaspis* Voichyshyn, gen. n.

Derivation of name. After Dr. P. P. Balabai (1904–1961).

Type species. *Pavloaspis pasternaki* sp. n.

Diagnosis. Pteraspids of average size. Carapace is elongated (its length is about 10 cm) and massive. The length of rostral plate is fourth the whole length of dorsal carapace. Index RL/RW 0.8. Pineal plate is large and rounded, without any contact with small orbital plates. Anterior and median orbital processes are short and pointed. Cornual plates are elongated and not wide. Dorsomedial sensory canals are of radial type.

Comparisons. New taxon differs from other representatives of Pteraspidoidei by morphology of orbito-pineal belt (an extent of isolation of component belt elements bears resemblance to that of Protopteraspididae and Pteraspididae, difference is in shape and size of plates). Besides this, Protopteraspididae has different shape of rostral

**Table 1. Measurements of dorsal carapace of pteraspid forms described, mm**[9]

**Таблица 1. Промеры дорсального панциря описанных форм птераспид, мм**

| № | DL | DW | RL | RW | PL | PW | OL | BrL | CL | CW | tL | cr/mm[10] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Alaeckaspis verbivciensis* | | | | | | | | | | | |
| 31395/1 | >80 | (46) | — | (29) | — | — | 35.3 | 49 | ≥31 | — | >100 | 8 |
| 31395/2 | ≥80 | 46.3 | >18 | 31 | — | — | — | 45 | >16 | 5.2 | >101 | — |
| 31395/3 | ≥88 | 49.5 | — | — | — | (12) | — | — | — | — | — | 8 |
| 31399/1 | >87 | 48.2 | 31.2 | 35 | 9.9 | 13.6 | 38 | — | — | — | >120 | 5–7 |
| 31399/2 | ≥81 | — | >20 | — | — | — | 32 | (41) | — | — | >101 | 9 |
| 31399/3 | ≥77 | — | — | — | — | — | — | >31 | ≥40 | — | >91 | 7–9 |
| 31399/4 | ≥85 | — | — | — | (8) | (11) | 34 | — | >31 | 6 | >109 | 7–8 |
| 31412/1 | >78 | 48 | >20 | 37.7 | (8) | (12) | — | 43.4 | >26 | ≥5 | >102 | — |
| 31412/2 | ≥76 | 45 | — | 35 | — | — | — | 45 | — | — | >102 | — |
| 37712 | ≥81 | — | >21 | >26 | 7.9 | 11 | 31 | — | — | 5.6 | >103 | 6–9 |
| 37718 | (83) | 48.8 | ≥27 | 33.5 | — | — | — | >31 | (47) | 5 | ≥114 | 7–11 |
| 37719 | ≥91 | 53 | — | (36) | — | (12) | — | — | — | — | >115 | 8–9 |
| | *Alaeckaspis ustetchkiensis* | | | | | | | | | | | |
| 37682 | 74 | 42 | — | (32) | 8 | 11 | 33 | ≥38 | 25 | 3.7 | >89 | 5–8 |
| | *Pavloaspis pasternaki* | | | | | | | | | | | |
| 37585 | >75 | (44) | 26.2 | 31.3 | 6.5 | 6.6 | 26.2 | >29 | >28 | 5.8 | >101 | 6–9 |
| | "*Pteraspis*" *angustata* Alth, 1874 | | | | | | | | | | | |
| 37565 | ≥48 | ≥26 | — | — | — | — | — | — | — | — | — | 5–6 |
| 37572 | >52 | 32 | — | — | — | — | — | — | — | — | — | 5–6 |
| 37581 | ≥60 | 36 | — | — | — | — | — | — | — | — | — | 6 |
| 37596 | 59 | 34.7 | — | — | — | — | — | — | — | — | — | 5–6 |
| 37612 | ≥48 | 28.5 | — | — | — | — | — | — | — | — | — | 5–6 |
| 37769 | 44 | 25.6 | — | — | — | — | — | — | — | — | — | 6 |

and dorsal plates, different arrangement of pineal component of supraorbital sensory canals ("pineal" canal), less general size. Pteraspididae has different shape of dorsal shield, Podolaspididae has that of cornual plates, Rhinopteraspididae that of rostral plate, Protaspididae that of dorsal, branchial and cornual plates. Shape and size of dorsal, rostral and cornual plates look like those of some Larnovaspididae representatives (*Larnovaspis*, *Djurinaspis*, *Alaeckaspis* gen. n.).

Remarks. In modern classification genus in test could belong to new family which together with Podolaspididae and Larnovaspididae could be the third phylogenetic branch of Podolian pteraspids derived from primitive forms which were like *Protopteraspis*. But I refrain from foundation of new family so long as taxon described is known by the single specimen only.

Occurrence. Lower Devonian of Podolia, Ukraine.

***Pavloaspis pasternaki*** Voichyshyn, **sp. n.** (fig. 4)

Material. Holotype.

Derivation of name. After Dr. S. I. Pasternak (1889–1994).

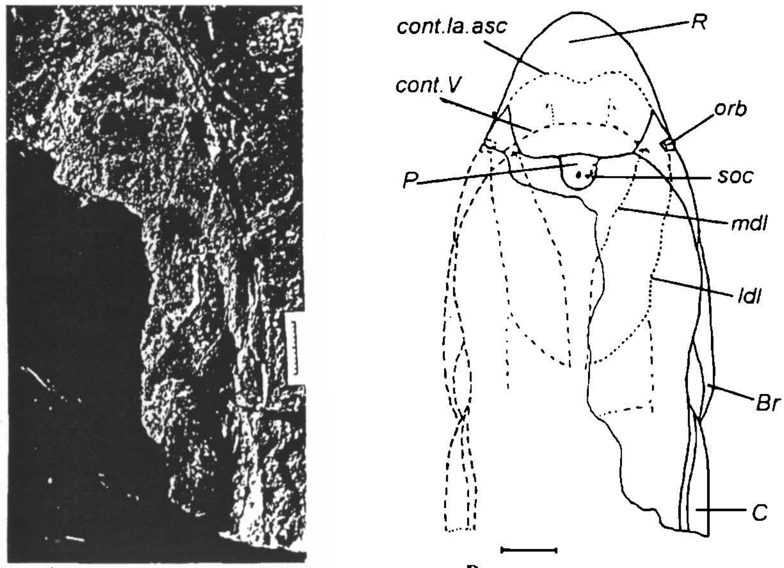
Type specimen. Holotype, specimen SMNH № 37585 a-b; a mould of both dorsal and ventral plates and fragmentary impress of antero-lateral part of dorsal carapace.

Type locality. Ukraine, Podolia, the left bank of Dniester, Ustechko.

Type horizon. Lochkov, Dniester Series, probably about the boundary between Ustechko Suite and Khmeleva Suite.

[9] Approximate values of measurements are in parentheses.

[10] The width of dentine ridges within one specimen, depending on part of measurement, has different values, but it is fairly stable for the same parts of diverse specimens (see, e. g., this measuring for specimens of "*Pteraspis*" *angustata* as all of them are the dorsal shields).




A B

Fig. 4. *Pavloaspis pasternaki* A, holotype, fragmentary impress of antero-lateral part of dorsal carapace (SMNH, № 37585). B, reconstruction of the carapace, dorsal view: *cont. la. asc* — contour of ascendant lamella on ventral side of rostral plate, *cont. V* — position of anterior margin of ventral plate, *orb.* — orbit, other designations are the same as in previous figures.

Рис. 4. *Pavloaspis pasternaki* A, голотип, частичный отпечаток антеро-латеральной части дорсального панциря (ДПМ, экз. № 37585). В, реконструкцяя панциря с дорзальной стороны: *cont. la. asc* — контуры восходящей пластинки (полоска) на вентральной сторонс рострапьной пластинки, *cont. V* — расположение переднього края вентральной пластинки, *orb.* — орбита, другие обозначения те же, что и на предыдущих рисунках.

Description. Dorsal carapace is relatively wide and fairly massive. Ventral length of rostral plate (from anterior margin to medial crime) is about half the dorsal one. Pineal plate is large and in general rounded (nearly round in shape) with approximately the same width and length. It forms hardly visible "hornlets" which are directed laterally and situated on the border between rostral and dorsal plates. Pineal plate takes up about 1/5 of orbito-pineal belt length. The plate is detached from orbital ones by intervals which nearly equal to plate's width. Maximum width of dorsal shield is in prebranchial part (DW/DL about 0.6). The shield gets narrow in the region of branchial openings. Branchial plates are relatively short. Branchial openings are fairly long (about 1.5 cm) and lens-shaped. Cornual plates are elongated and not wide. Supraorbital sensory canals cut the border of pineal plate in the "hornlets" region. Dorsomedial canals diverge in radial manner to (base of) medial orbital processes. There are 6 cr/mm on the dorsal shield and as many again on the dorsal side of rostral plate and 9 cr/mm on the ventral side of latter.

## Incertae familiae

### "*Pteraspis*" *angustata* Alth, 1874 (fig. 5)

*Pteraspis angustatus*: Alth, 1874, S. 45 (pars), Taf. III, fig. 6, 7 (sol.).
*Pteraspis sturi* Alth sp., mut. *rostrata*: Zych, 1927, tabl. II, fig. 6.
*Pteraspis concinna*: Brotzen, 1933, S. 453–454, Abb. 14.
*Rhinopteraspis* (=*Belgicaspis*) *crouchi*: Blieck, 1984, p. 34.

Material. Specimens SMNH, № 37565, 37572, 37581, 37596, 37612, 37769 (the moulds or impresses of dorsal shields).

Type specimen. Lectotype which was depicted in the publication of A. Alth (1884: taf. III, fig. 6–7).

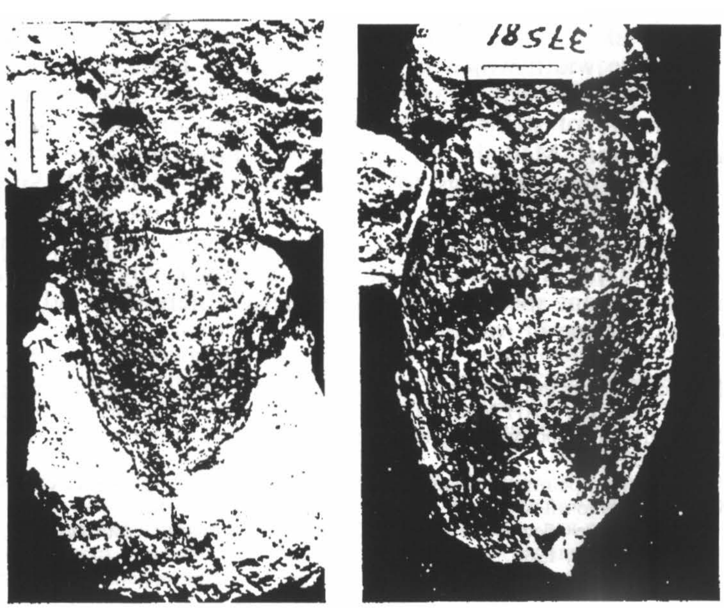
Type locality. Ukraine, Podolia, the right bank of Dniester, Khreshchatyk. Lochkov, probably, the base of Ustechko Suite.

Description. Dorsal shield is not large (its length equal to 4.5–6 cm; DW/DL 0.54–0.60), with maximum width in fore-part. The shield gets narrow in postbranchial part and stretches in acute-angled projection to the caudal end. Hollow of pineal plate is deep and clear outlined. Groove of dorsal process is relatively long and narrow. Dorsal process in its base gently slopes up backwards. Dorsomedial sensory canals are radial. Dentine ridges of ornamentation are wide (5–6 cr/mm).

Comparisons. "*P.* " *angustata* is like *Rhinopteraspis dunensis* (Roemer, 1855) by shape of anterior and posterior shield margins, but differs from this species by considerably lesser size. In contrast to *Belgicaspis crouchi* (Lankester, 1868) (Blieck, 1984: p. 78, fig. 37C) it has deeper pineal hollow in anterior shield margin, narrower back part of shield (on the level of postero-lateral angles) and lesser size.

Remarks. According to L. I. Novitskaya (1986: p. 82) and in spite of F. Brotzen's opinion (Brotzen, 1933: p. 441), specimen which was figured in Zych's publication (Zych, 1927: tabl. II, fig. 6) has been attributed to *Podolaspis podolica* (Alth, 1874). On condition it is right, that shield must be considered as juvenile dorsal plate, since after Novitskaya (1986: fig. 31, 32) definitive plate has other shape and size. But juvenile plate of *P. podolica*, as one can observe in specimen PIN № 3592/43 (ibid.: fig. 32), also bears no resemblance to Zych's specimen.

Localities. Ustechko, Khreshchatyk (Ustechko Suite — the base of Khmeleva Suite).



A B

Fig. 5. "*Pteraspis*" *angustata* Alth, 1874. A, B, the moulds of dorsal shields (collection of SMNH), correspondingly, № 37769, 37581.

Рис. 5. "*Pteraspis*" *angustata* Alth, 1874. A, B, ядра дорсальных щитов (коллекция ДПМ), соответственно, № 37769, 37581.

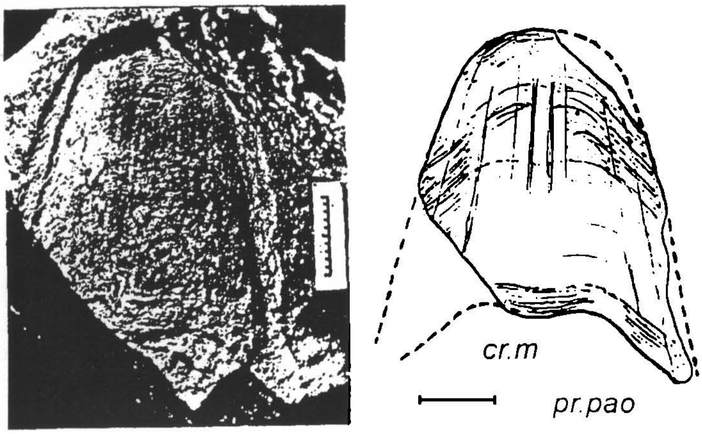



Fig. 6. Pteraspidoidei inc. sed. (SMNH, № 37633). A, fragmentary impress of ventral surface of rostral plate. B, reconstruction of the specimen: *cr. m* — medial crest, *pr. pao* — paraoral projection.

Рис. 6. Pteraspidoidei inc. sed. (ДПМ, екз. № 37633). А, частичный отпечаток вентральной поверхности ростральной пластинки. В, реконструкция образца: *cr. m* — медиальный гребень, *pr. pao* — параоральный выступ.

## Pteraspidoidei incertae sedis (fig. 6)

Material. Specimen SMNH, № 37633 (fragmentary impress of ventral surface of rostral plate); Chekhiv (? Strypa Suite).

Description. Rostral plate is elongated, widely rounded anteriorly and as a whole has trapezium-like shape, with, probably, straight lateral margins. Its dorsal length exceeds the plate width which is not less than 45 mm. Its ventral length is 39 mm. Ventral side of plate doesn't have preoral field and is covered with transversal dentine ridges which are of stable width (it equals to 6 cr/mm). Ascendant lamella seems to be relatively short. Medial crest and paraoral projections are smoothed out.

Remarks. Rostral plate belongs to large widesnout pteraspid. Specimen shows resemblance to representatives of genus *Althaspis* by lack of preoral field and by character of ventral surface ornamentation what, likely, indicates their relationship. But the difference is in wide shape of anterior plate's end and probably in less value of index RL/RW. In general, present specimen quite distinctly differs from other known today Podolian pteraspids by shape of rostrum.

*Дригант Д. М.* Девонські відклади Волино-Поділля (стратиграфія, кореляція розрізів). — Львів, 1988. — 46 с. — (Препринт / АН УРСР. Ін-т геології і геохімії горючих копалин; N 88–1).

*Нарбутас В. В.* Красноцветная формация нижнего девона Прибалтики и Подолии. — Вильнюс : Мокслас, 1984. — 135 с.

*Новицкая Л. И.* Морфология древних бесчелюстных (гетеростраки и проблема связи бесчелюстных и челюстноротых позвоночных). — М. : Наука, 1983. — 184 с.

*Новицкая Л. И.* Древнейшие бесчелюстные СССР. Гетеростраки: циатаспиды, амфиаспиды, птераспиды. — М. : Наука, 1986. — 160 с.

*Alth A.* Über die paläozoischen Gebilde Podoliens und deren Versteinerungen // Abhandlungen von der K. K. geologischen Reichsanstalt Österreich. — Wien, 1874. — **7**, № 1. — 80 S.

*Blieck A.* Les Hétérostracés (Vertébrés Agnathes) de l'horizon *Vogti* (Groupe de Red Bay, Dévonien inférieur du Spitsberg). — Paris : éd. CNRS, 1982. — 51 p. (Cah. paléontol. sect. Vertébrés).

*Blieck A.* Les Hétérostracés Pteraspidiformes. Systématique, phylogénie, biostratigraphie, biogéographie. — Paris : éd. CNRS, 1984. — 199 p. (Cah. paléontol. sect. Vertébrés).

*Brotzen F.* Die silurischen und devonischen Fischvorkommen in Westpodolien. I // Palaeobiologica. — 1933. — **5**, № 3. — S. 423–466.

*Brotzen F.* Beiträge zur Vertebratenfauna des westpodolischen Silurs und Devons. I. *Protaspis arnelli* n. sp. und *Brachipteraspis* n. gen. *latissima* Zych // Arkiv för zoologi. — 1936. — 28 A, **22**. — 52 S.

*Zych W.* Old-Red Podolski // Prace Polskiego Instytutu Geologicznego. — Warszawa, 1927. — **2**, zesz. 1. — 65 s.